FUSES AND FUSE PANELS

INSPECTION

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1. GENERAL

1.01 This section covers the inspection of fuse panels, capacity (amperes) ratings, and the description of 24-, 35- (regular and nonflashing), 70-, 74-, 75-, 76-, 77-, and 78-type fuses. This section does not apply to fuses in the high-voltage circuits which supply the transformers from which the power service for the office is obtained. These circuits are usually maintained by the Power Company employees.

1.02 Revision arrows are used to emphasize significant changes. The Equipment Test List is affected. The reasons for reissue are listed below.

NOTICE
Not for use or disclosure outside the
Bell System except under written agreement

(a) To add the 24G-, 74H-, 74J-, 76-, 77-, 78-, and link-type fuses

(b) To add additional information on cartridge-type fuses.

1.03 ***DANGER: Extreme care must be taken when working on or near equipment with high current capability and/or when high voltage is present. To prevent bodily injury, bracelets, rings, key chains, wrist watches, metal belts, and buckles should not be worn while inspecting or maintaining electrical equipment. Insulated tools, gloves, and mats should be used at all times. However, it is not necessary to use an insulating mat when working on dc distributing boards which do not exceed 135 volts.***

1.04 ***Caution: It is recommended that work on live equipment be performed during periods of light traffic. Each exception, including the temperature test of discharge fuses or removal of defective fuses, should be discussed with the supervisor before work is started since the removal of even an apparently minor fuse may result in a service interruption.***

1.05 A defective fuse should not be removed until a spare fuse is available, and the fuse can be replaced immediately after any necessary jumpers have been installed.

1.06 The following Bell System Practices are referenced within this section:

SECTION	TITLE
026-370-701	Fuses, Mountings, and Enclosures—Requirements and Adjusting Procedures
030-740-701	Knife—Switches—Requirements and Adjusting Procedures
171-115-501	Checking Load On Individual Leads

2. DESCRIPTION

A. 24-Type Fuses

2.01 Both the code and the rating capacity are stamped into the metal bands on the 24-type nonalarm fuse. To aid in identifying the fuse code, the rating capacity and a small rectangle are now being stamped in a unique color for each code on both sides of the fuse. In some of the older installations, the 24A fuse is furnished in 1/2 and 1-1/3 ampere ratings and the 24B fuse in 1/2, 1-1/3, 2, 3, 4, and 5 ampere ratings. Table A lists the code stamping, color, and the rated capacity as now applied to the 24-type fuse.

TABLE A

24-TYPE FUSE RATINGS

CODE	COLOR	CAPACITY (AMPERES)
24B	Blue	3
24B (A&M)	Yellow	4
24C	Orange	2
24D	Black	3/4
24E	Red	1/2
24F	Green	5
24G	White	1-1/3

B. 35-Type Fuses

2.02 A commonly used fuse is the 35-type which may be either "regular" or "nonflashing." The nonflashing type differs from the regular type in that the fuse wire of the nonflashing fuse is protected by a glass or melamine phenolic (or porcelain) tube which restricts flashing during operation. The regular fuse should be used whenever suitable. Nonflashing fuses are required for certain circuits above 90 volts. This is especially true where the 35-type fuse parallels a distribution fuse and hence may be subject to high-current flow if the distribution fuse operates. To determine type of fuse required by any specific circuit, check fusing requirement data for that circuit. Note 101 on the schematic drawing for the circuit in question will include designation "HV" beside the fuse capacity if a nonflashing fuse is required.

2.03 With three exceptions, the rated capacity of the 35-type fuse can be determined by the color of the bead on the fuse or by the color of the fuse insulating strip. The three exceptions are the 3- and 5-ampere 35B fuse and the 3-ampere 35E fuse, each

of which is equipped with a white bead that is generally indicative of the 1-1/3 ampere rated capacity.

C. 67-Type Fuses

2.04 The flat 67A (20 ampere) and the flat 67B (30 ampere) alarm fuses are used with the KS-5556 (Mfr Disc.) fuse mounting.

D. 70-Type Fuses

2.05 The 70-type fuse performs functions similar to the 35-type fuse, but the nonflashing type is not required since the 70-type fuse is completely enclosed.

2.06 The rated capacity of a 70-type fuse with normal operating time characteristics can be determined by the solid color of the plastic indicating bead projecting beyond the cap. A slow-acting 70-type fuse will have a longitudinally striped bead with three stripes of color separated by three stripes of white. Table B lists the colors used to indicate the rated capacity of the 35- and 70-type fuses.

2.07 A small designation pin, having a head of solid color or a ring of color (eyelet), is provided in mountings for 70-type fuses to designate the fuse capacity. The color of the fuse indicating bead should correspond to the color of the designation pin. A pin having a head of solid color is used with a fuse having normal operating time characteristics. The ring of color (eyelet) indicates a slow-acting fuse. The solid pins are coded KS-14174 designation pins. The eyelets are coded KS-16078 designation pins. Table C gives the list numbers for the various colors.

2.08 Where interruptions to battery supply have been experienced due to a slight movement of the fuse cap on 23- to 27-type fuse blocks used with 70-type fuses, it is recommended that a P-21E546 neoprene washer be added to fuse caps now in the

TABLE B

35- AND 70-TYPE FUSE RATINGS

35-TYPE REGULAR	35-TYPE NON-FLASHING	70-TYPE	COLOR	CAPACITY (AMPERES)
		70P*	Gray & White	0.100
		70R*	Red & White	.150
35R		70E	Yellow	0.180
	35S		Violet	1/4
		70F	Violet (formerly Pink)	1/4
		70K*	Violet & White (formerly Blue-Green)	1/4
35F	35J	70G	Red	1/2
35T			Tan	0.650
	35P		Brown	3/4
		70H	Brown (formerly Tan)	3/4
35A	35K	70A	White	1-1/3
35B (A&M)			White	1-1/3
35D (A&M)			White	1-1/3
35B (A&M)			Orange	2
35C	35L	70B	Orange	2
35E (A&M)			White	3
35G	35M	70C	Blue	3
35H	35N	70D	Green with Black Stripe	5

* Slow-acting fuse.

♦TABLE C♦

LIST OF FUSE DESIGNATION PINS

KS-14174 (70-TYPE FUSE)		KS-16078 (EYELET) (70-TYPE SLOW-BLOW FUSE)		L-747462 (77-, 78-, 80-, AND 81-TYPE FUSES)		
LIST NO.	PIN COLOR	LIST NO.	PIN COLOR	PART NUMBER	PIN COLOR	FUSE RATING (AMP)
1	White	2	Red	843292343	White	1.33
2	Orange	3	Brown	843292350	Orange	2.00
3	Blue	4	White	843292368	Blue	3.00
4	Green	5	Gray	843292376	Green	5.00
5	Yellow	6	Violet	843292384	Yellow	10.00
6*	Pink			843292392	Gray	7.10
7	Red			843292400	Red	0.50
8	Brown (formerly Tan)			843292418	Brown	0.75
9*	Blue-Green			843292426	Violet	4.00
10	Violet			843292434	Black	15.00
				843292442	Gold	20.00

* Rated Mfr Disc.

field. New production 23- to 27-type fuse blocks have been modified and do not require the neoprene washer. In order to identify the new production 23- to 27-type design (Fig. 1), circular mounting screw holes are used on the new design fuse block covers whereas rectangular holes are used on the old design. Neoprene washers should not be used on fuse caps used on 18- to 22-type fuse blocks.

2.09 In circuits of 130 volts or more where a low resistance to ground exists, the installation of 70-type fuses may result in arcing and destruction of the fuse blocks. Prior to initial fuse installation in new circuits, the resistance of the load circuits to ground should be checked using a 742A tool and KS-14510 volt-ohm-milliammeter.

E. 74-Type Fuses

2.10 The 74-type fuse codes shown in Table D were developed for initial use in the 1A processor circuits of the No. 4 Electronic Switching System (ESS). These fuses are of a nonalarming and nonindicating design and are packaged in 9/32 by 1-1/4 inch tubular bodies. Such characteristics have been determined to better meet the requirements of systems using electronic devices and dc-to-dc converters.

2.11 These fuses are a new series of fuses, designed to have significantly lower resistance and/or blow times that are up to an order of magnitude faster than the 70-type or KS-19780 type fuses. ♦The maximum voltage rating of the 74-type fuses is 60 volts dc.♦

2.12 The 74-type fuses have been designed to be mounted in existing 20A or similar modular fuse blocks in equipment areas where the no-fault current applied to the fuses does not exceed 80 percent of the applicable rated current. The proper fuse cap to use when mounting the 74-type fuses is the latest production version of the P-12F160 ♦or P-21E517♦ fuse cap, which can be identified by two spherical raised dots on its front face.

F. 75-Type Fuses

2.13 The 75A, B, and C fuses consist of a resistor enclosed in a spring loaded plastic case. They are designed to be used in telephone sets to provide protection against foreign voltages impressed be-

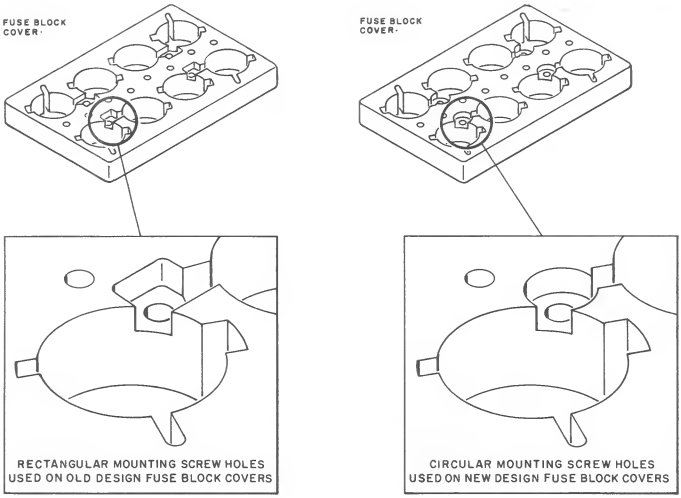
FUSE BLOCK COVER
FUSE BLOCK COVER
RECTANGULAR MOUNTING SCREW HOLES USED ON OLD DESIGN FUSE BLOCK COVERS
CIRCULAR MOUNTING SCREW HOLES USED ON NEW DESIGN FUSE BLOCK COVERS

Fig. 1—Identification of Old and New Design Fuse Block Covers

tween the tip and ring leads. These fuses are designed to be mounted to 3/32-inch thick printed circuit boards. The 75A fuse shall not be used where the normal circuit current exceeds 0 .200 ampere. The 75B fuse shall not be used where the normal circuit current exceeds 0.115 ampere. The 75C fuse shall not be used where normal circuit current exceeds 0.007 ampere. When the current capacity indicated in Table E is flowing through the 75A or B fuse, it shall open the circuit within 1 minute. When the voltage capacity indicated in Table E is applied to the 75C fuse, it shall open the circuit within 40 minutes.

G. 76-Type Fuses

2.14 The 76-type fuses were developed to provide protection against the application of foreign voltages to equipment such as data sets and telephone sets. These fuses consist of a resistor enclosed in a spring loaded plastic case.

2.15 The 76A fuse shall not be used where the normal circuit current exceeds 0.231 ampere. The 76B fuse shall not be used where the normal circuit current exceeds 0.191 ampere. The 76C fuse shall not be used where the normal circuit current exceeds 0.413 ampere. The 76D fuse shall not be used where the normal circuit current exceeds 0.0125 ampere. When the current capacity, indicated in Table F, is flowing through the 76A, B, or C fuse, it will open the circuit within 1 minute.

TABLE D

74-TYPE FUSES

CODE	CAPACITY (AMPS)
74A	1.25
74B	3.0
74C	5.0
74D	10.0
74E	15.0
74F	20.0
74G	2.0
74H	4.0
74J	7.5

TABLE E

75-TYPE FUSE RATINGS

CODE	CAPACITY	RESISTANCE (OHMS)
75A	0.600 Amp	9.2 to 11.1
75B	0.345 Amp	27.6 to 33.3
75C	300 Volts	7544 to 9102

TABLE F

76-TYPE FUSE RATINGS

CODE	CAPACITY	RESISTANCE (OHMS)
76A	1.0 Amp	13.8 — 16.65
76B	0.825 Amp	20.24 — 24.42
76C	1.8 Amps	4.32 — 5.22
76D	275.0 Volts	4692 — 5661

H. 77- and 78-Type Fuses

2.16 The 77- and 78-type fuses listed in Table G were developed for use in circuits where a fast-blowing, low-resistance characteristic is desirable with opto-electronic alarming and indicating features. A red light-emitting diode (LED) is mounted in the front end of the fuse and one of its terminals is connected internally to the load side of the fusing element. The other LED terminal is used as an alarm or indicating circuit terminal. When the fuse element opens, the LED illuminates and can trigger an alarm circuit. The fusing element is mounted to the side rail terminals at the rear of this fuse package and is protected by a plastic snap-mounted cover. This three-terminal fuse package is similar in size to the 552-type LED.

TABLE G

77- AND 78-TYPE FUSE RATINGS

FUSE CODE	CAPACITY (AMPS)
77A, 78A	1.25
77B, 78B	3.0
77C, 78C	5.0
77D, 78D	10.0
77E, 78E	15.0
77F, 78F	20.0
77G, 78G	2.0
77H, 78H	4.0
77J, 78J	7.5
77K, 78K	0.5
77L, 78L	0.75

2.17 The 77- and 78-type fuses have essentially the same resistance, voltage rating, and clearing time as the 74-type fuses. The 77-types are for positive voltage applications and the 78-types are for negative voltage applications. A colored stripe is painted on the side of the LED lens to identify the fuse rating (See Table C) when the fuse is mounted.

2.18 The 77-type fuses were designed to be mounted in the 31A fuse blocks on the front edge of printed circuit boards or in 34A, 34C, and 34E fuse blocks located on flat panels, by mechanical in-

dexing of mating surfaces. The 78-type fuses were designed to be mounted in the 31B fuse block on the front edge of printed circuit boards or in 34B, 34D, and 34F fuse blocks located on flat panels. In such mountings, the no-fault current applied to the fuses should not exceed 80 percent of applicable rated current.

2.19 A small designation pin, having a head of solid color, is provided in the mountings for the 77- and 78-type fuses to designate the fuse capacity. The color of the painted stripe on the LED lens of the fuse should correspond to the color of the designation pin. Table C lists the part numbers and colors for these designated pins.

I. Cartridge-Type Fuses

2.20 The KS-15763 cartridge-type fuses are of high-capacity, inverse time-delay type. Their current ratings range from 700 to 1750 amperes with potentials up to 600 volts. The KS-15763 cartridge-type fuses are used in protecting motor-generator sets where parallel fusing is now required for handling loads exceeding 600 amperes. They are also used in discharge circuits where open link fuses are now used.◀

3. APPARATUS

3.01 ***List of Tools, Material, and Test Equipment:*** The following list of tools, material, and test equipment is used in this section.

TOOLS	DESCRIPTION
319B	Lamp Cap Extractor Pliers
716C	Lamp Receiver Tool (or equivalent)
742A	Tool (consists of a modified fuse cap equipped with a 4-foot cord terminated in a connector compatible with the KS-14510 volt-ohm-milliammeter.)
AT-7825	3-Inch D Screwdriver
AT-7825	4-Inch E Screwdriver
—	Puller, Fuse, 7-1/2 inches long, for 0-200 amperes, Ideal Industries, Inc (or equivalent)
—	Puller, Fuse 12-inches long, for 100-600 amperes, Ideal Industries, Inc (or equivalent).
—	Fuses (as required)
MATERIAL	
—	Dummy Fuses (as required)
R-3266	NO-OX-ID* "A" Compound
TEST EQUIPMENT	
KS-14510	Volt-Ohm-Milliammeter (or equivalent)
▶R-1032◀	Thermometer (or equivalent)
—	Dry Battery Supply

4. METHODS

A. 24-Type Fuses

4.01 To check 24-type fuses, proceed as follows:

(a) Verify that the fuse mounting screws are tight by testing in the direction of tightening with the 3-inch D screwdriver.

(b) Verify that all unused fuse spaces are equipped with 64A dummy fuses.

(c) Verify that the spare fuse holders contain a full supply of spare fuses of the required capacity.

B. 35-Type Fuses

4.02 To check 35-type fuses, proceed as follows:

(a) Verify that all fuses are of the proper capacity, as indicated by the marking on the fuse panel. Fuse capacity may be determined by checking the color of the bead on the fuse or the color of the fuse insulating strip, as shown in Table B.

(b) Verify that all fuses are of the proper type either nonflashing or regular. This inspection

* Registered trademark of Sanchem, Inc.

can be made by checking for the presence or absence of the glass bead or porcelain tube on the fuse wire. See Table B for the nonflashing fuse codes. The code should be marked on the fuse panel when the nonflashing fuse is required.

(c) Inspect all fuses to make certain that none have been damaged to such an extent as to prevent proper operation. When it appears questionable whether a fuse will make contact with the alarm stud or the alarm bar when the fuse operates, the fuse should be replaced.

(d) Verify that the fuse mounting screws are tight by testing in the direction of tightening with the 3-inch D screwdriver.

(e) Verify that all fuses are mounted properly with the side mounting slot attached to the live side of the circuit. Unless otherwise specified, horizontally mounted fuses have the side mounting slot on the right or bottom.

Note: On some frames, bays, and panels, battery is supplied through a cartridge- or plug-type fuse and a paralleling-alarm fuse. In such cases, a small fillister head screw or a projecting tip is provided at the position of the vertical mounting slot as a guard against the improper placing of the alarm fuse.

(f) Verify that all unused fuse spaces are equipped with 63A dummy fuses.

(g) Verify that the spare fuse holders contain a full supply of spare fuses of the required type (regular and nonflashing) and capacity.

C. 67-Type Fuses

4.03 To check 67-type fuses, proceed as follows:

(a) Verify that the KS-5556 (Mfr Disc.) fuse mountings are secure by testing the mounting screws in the direction of tightening with the 4-inch E screwdriver.

(b) Verify that the fuse mounting screws in the spare KS-5556 (Mfr Disc.) fuse mountings are tight by testing in the direction of tightening with the 3-inch D screwdriver. Verify that the fuses are of the proper capacity.

(c) Verify that the spare fuse holders or cabinets contain an adequate supply of spare fuses of the required capacity.

D. 70-Type Fuses

4.04 To check 70-type fuses, proceed as follows:

(a) Verify that all fuses are of the proper capacity by comparing the color of the fuse indicating bead with the color of the designation pin or eyelet on the fuse mounting.

(b) Verify each fuse to make certain the plastic indicating bead is ***not*** jammed under the alarm cap.

(c) Verify that all unused fuse spaces are equipped with 72-type dummy fuses.

(d) Verify that the spare fuse holders contain a full supply of spare fuses of the required capacity.

E. 74-Type Fuses

4.05 To check 74-type fuses, proceed as follows:

(a) Verify that all fuses are of proper capacity, as indicated by the marking on the fuse panel.

(b) Verify that the spare fuse holder or cabinets contain an adequate supply of spare fuses of the required capacity.

F. 75- and 76-Type Fuses

4.06 To check 75- and 76-type fuses, proceed as follows:

(a) Verify that all fuses are of proper capacity, as indicated by the marking on the printed circuit board.

(b) Verify that the spare fuse holder or cabinet contains an adequate supply of spare fuses of the required capacity.

G. 77- and 78-Type Fuses

4.07 To check 77- and 78-type fuses, proceed as follows:

(a) Verify that all fuses are of proper capacity, as indicated by markings or by color matchings of the fuse's painted stripe and the designation pin on the fuse mounting.

(b) Verify that all fuses are firm in their mountings by pushing the fuse towards the front

face of the mounting and up against the raised surface located on one side of the front face.

(c) The 77- and 78-type fuses may be inserted into and extracted from their mountings through use of the 319B tool. To remove fuses, insert the plier jaws into the rectangular slots located on the front face of the mounting and behind the fuse lens, squeeze jaws against sides of lens, and pull out the fuse.◀

H. Cartridge-Type Fuses

4.08 ***Caution: Removal of a fuse may result in a service interruption.*** To check cartridge-type fuses, proceed as follows:

(a) Verify that all fuses are of the proper capacity as indicated by the marking on the fuse panel. The dead front panel has a designation strip on the outside of the panel.

(b) Inspect all fuses and fuse clips for corrosion.

Note: The procedures for cleaning fuses and fuse clips are covered in Section 026-370-701. The section also covers the apparatus requirements and adjusting procedures for ferrule-type cartridge fuses and fuse mountings.

(c) Using a fuse puller to turn the fuses, test for secure mounting of ferrule-type cartridge fuses in their clips. Always leave fuses with their capacity labels visible and turned outward away from the fuse panel.

▶(d) Test knife blade-type fuses for secure mounting by attempting to shake or wiggle the fuse, in its mounting, using a fuse puller. [See Step (e).]◀

Note: Clips for knife blade-type fuses may be checked and adjusted, as outlined in Section 030-740-701 covering knife switches.

(e) Examine the fuse clips or blades and mountings for blued or burned areas, which are an indication of excess heat at present or in the past. As outlined in Section 026-370-701, when there is evidence of excessive heating, a complete check should be made of all requirements and the defective parts should be replaced.

(f) Periodic checks may be made of fuse temperatures on the main discharge fuses during peak traffic loads. After discussing the matter with the supervisor, proceed as follows:

(1) Temperature checks, using an R-1032 thermometer, may be made as outlined in Section 026-370-701.

(2) When the voltages are not considered hazardous to personnel, temperature checks, using the fingers, may be made by lightly touching the metal fuse ends, fuse body, and fuse mountings. If the parts do ***not*** feel abnormally warm to the touch, the temperature should be considered satisfactory.

(g) Where there is no evidence of mechanical difficulty, excessive fuse temperatures may be caused by overloading. Refer to Section 171-115-501 on methods of checking the load on fuses in service.

(h) Spare cartridge fuses may be tested by passing current through the fuse and a milliammeter, using the test desk (or other) dry battery supply for testing. The current flow reading should remain constant with the fuse in or out of the circuit. Fuses showing a resistance reading should be referred to the supervisor.

(i) Verify that the contact surfaces of spare fuses are clear of oxide and are coated with a light film of NO-OX-ID "A" compound.

(j) Verify that all unused fuse spaces on open type fuse panels are equipped with dummy fuses. Dummy fuses are not required in KS-14473 or KS-16364 fuse blocks as well as all other enclosed types used on dead front fuse panels. The 72A-type dummy fuses, which are intended to retain the fuse caps during shipment, shall continue to be used as required. The 72A-type dummy fuses shall not be used with the KS-14169, L6, fuse caps. (List 6 caps have no hole for an alarm indicator.)

(k) Verify that the spare fuse holders or cabinets contain an adequate supply of spare fuses of the required capacity.

I. Link-Type Fuse

▶**4.09** To check the KS-19392, L12 through L16, link-type fuse, proceed as follows:

(a) Verify that all fuses are of the proper capacity, as indicated by the marking on the fuse panel.

(b) Verify that all fuse clamping nuts are securely tightened (190 inch-pounds).

Note: See Section 026-370-701 for requirements in tightening the clamping nuts.

(c) Check for fracture of the fusible links.

J. Plug-Type Fuses

4.10 ***Caution: Removal of a fuse may result in a service interruption.*** To check plug-type fuses, proceed as follows:

(a) Verify that all fuses are of the proper capacity, as indicated by the marking on the fuse panel.

(b) Verify that all fuses are firm in their sockets by attempting to turn the fuses in the direction of tightening.

(c) Verify that the spare fuse holders or cabinets contain an adequate supply of spare fuses of the required capacity.

K. Fuse Panels

4.11 ***Caution: Removal of a fuse may result in a service interruption.*** To check fuse panels, proceed as follows:

(a) Inspect all fuse panels for loose parts and mountings. Test screws in the direction of tightening with a 4-inch E screwdriver.

(b) Inspect visually for cracked or broken panels and damaged wiring. Report to the supervisor any defects found.

(c) When fuse panels are equipped with equipment guards, test the guards to make sure they are not grounded, using the 716C test receiver tool. Report any grounded guards to the supervisor.